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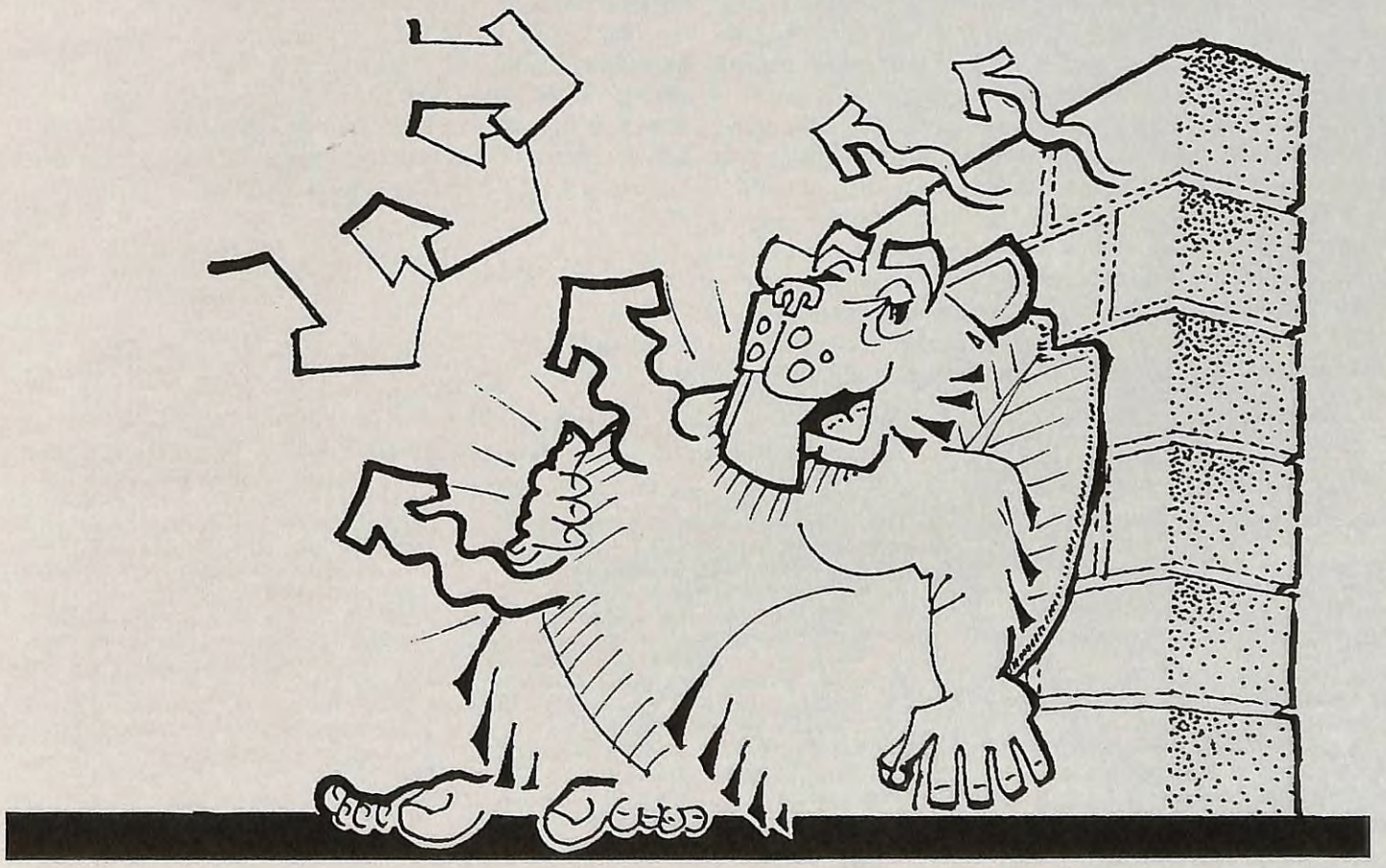
Thermal Mass and Energy Use



From the Editor . . .

Canada signed the Kyoto Protocol, thereby recognizing that human activities are having an impact on the earth's environment. The Kyoto Protocol, and the goals set to reduce emissions that have an impact on the earth, are only the starting point. By signing the international agreement, we as a nation made a commitment to reduce our impact on the environment. The building sector has a big part to play, since buildings represent a major portion of energy use, both in the construction process and in the operation of buildings over their lifetime.

As an industry we've made progress in recent years. Our homes are not only more comfortable, but also more energy efficient than they have been in the past. The hoary tales pioneers tell about how cold their houses were in the winter, and about how they had to chip ice off the inside of walls, etc. may be a bit of an exaggeration, but the fact remains that today's homes are more comfortable.

There are a few areas where energy efficiency upgrades are still elusive. In the past we've mentioned the phantom loads that consume so much energy - the many home appliances that consume power even when in the "off" position. Steps are being taken to deal with this issue.

However, there is one significant energy hog in our homes today that seems to be eluding us – the domestic water heater. Domestic water heating consumes a lot of energy. Domestic hot water consumption can easily account for one third or more of the energy required in a home. It is a constant energy user since we use water year-round, while energy to provide space heat is only needed for the coldest periods of the year. We also use more hot water today than any time in the past, but the technology for heating that water has not changed significantly.

We've come a long way with our space heating technology. Today gas furnaces with efficiencies in excess of 90% are readily available. However, I am dismayed to see that the water heating industry is still in the dark ages. The North American water heater manufacturers have created an industry based on planned obsolescence. They churn out water heaters that are abysmally inefficient and have a short life span, but the units are priced just cheaply enough that people will put up with having to replace their units every six or seven years. In the process, the inefficient heaters use much more energy than is justified, and contribute significant quantities of greenhouse gases.

High efficiency units are technically feasible. There are a few units on the market, but they are priced ridiculously high, almost to discourage people from buying them. Recently I discovered that Lennox and Polaris have teamed up manufacturing and increased the price for their high efficiency water heaters – a marvellous benefit from reduced competition. The price is about ten times that of the cheap disposable units, hence the disincentive to buy the better product. I have heard of another major manufacturer who has stated that their company won't even look at improving their product line until the government forces them to through regulation.

So much for market forces – don't let anyone have any viable options or price certain products ridiculously high to make sure no one buys them, so you can prove a point. Yet we know that the technology exists, as there are products available in other parts of the world not as beholden to the fossil fuel industry.

Perhaps it's time for government regulations to require higher performance water heaters. There will be moaning from the manufacturers, but they've had plenty of time to improve their products. If we are really to come to terms with climate change issues, then all energy consuming appliances must be dealt with. The water heating manufacturers seem to be one segment of the building industry that has not done its bit to improve the efficiency of its products.

Richard Kadulski,
Editor

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Thermal Mass and Energy Use

Thermal mass has been an important element in the construction of comfortable living environments around the world.

Adobe has been used to build houses throughout the southwestern United States and Mexico. These high thermal mass houses have walls that are made from thick sun-dried clay, sand, and straw bricks.

In the Mediterranean region of Southern Europe, whether in Spain, Italy, Greece, or along the north coast of Africa, the whitewashed masonry buildings provide comfortable indoor environments. Similar examples are found in other locations around the world with hot climates.

High mass buildings work because of a balance between the amount of thermal mass, its ability to store heat, and the local climate. It is the ability to store heat that makes high mass buildings interesting. Because of the heat storage capacity of masonry, the heat flow dynamics of masonry buildings differ from conventional lightweight wood frame construction.

This property of storing heat also creates confusion and misunderstanding among designers and builders. Although a mass wall may have less insulation than a frame wall, the total heating and cooling energy costs for the house with the mass walls could be lower. This happens because the thermal mass moderates the indoor temperature, reducing the load on the heating and cooling equipment. A large warmer surface also raises the mean radiant temperature, thus improving indoor comfort conditions.

However, caution must be used. When considering the benefits of thermal mass walls, it is important to recognize the climate conditions where the building is located, and the details used.

Thermal mass is very important for energy-efficient construction in climates such as those found in the southwestern US and Mexico. In the high altitudes of New Mexico, the intensity of the sun and the total hours of sunshine ensure a regular availability of solar energy to charge up the masonry walls. Cold nights are followed by warm if not hot days.

On the other hand, more northerly locations have shorter days with a much lower intensity of solar energy and a proportionately higher cloud cover, further reducing available solar energy. Daytime temperatures remain cold. This does not mean that solar energy or thermal mass are not beneficial at Canadian latitudes. Rather, the specific details and applications must be considered carefully with due regard to the climate of the building site.

Because of the heat storage capacity of masonry, the heat flow dynamics of masonry buildings differ from lightweight wood frame construction. This creates confusion and misunderstanding

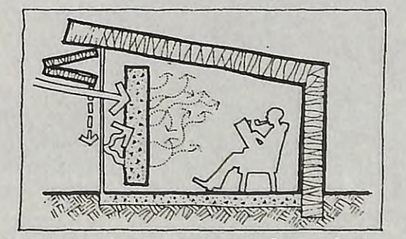
Buildings must be climate-adapted! We need to restate this, since many people seem to forget that you need to apply appropriate practices to the location where a building is located. You forget that at your peril.

Joe Lstiburek has made a career teaching building science principles and diagnosing problems when inappropriate details are used. An expensive example of this happened in the hot humid southeastern United States. Many builders and designers moved south, following the demographic migration to the sun belt. However, they kept using many of the same details and practices they had learned in Minnesota, Ontario or Saskatchewan, even though the climate conditions are completely different. As a result, many buildings have had to be rehabilitated soon after construction because of mould and fungal growth that were destroying them.

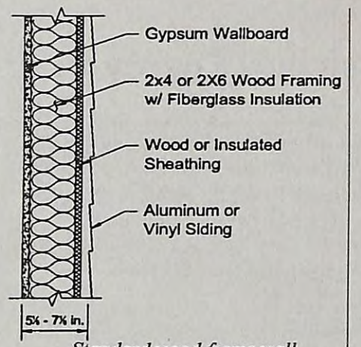
In the late 1970's and early 1980's, interest in solar energy applications meant a number of Trombe walls were built into many Canadian houses.

The Trombe wall was developed by Felix Trombe in southern France. It consists of a mass wall placed immediately behind south facing windows. The mass absorbs heat and releases it at night. It is a concept that works well in the Pyrenees of southern France and in New Mexico - locations with intense solar energy but cold nights due to the high altitudes. When the idea was applied to houses in Canada, monitoring results showed limited success here.

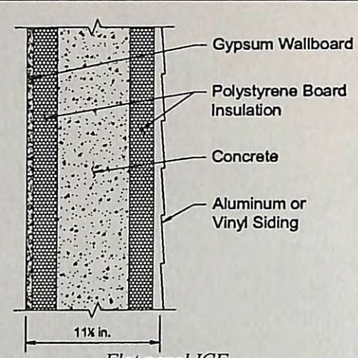
Appropriately designed thermal mass can be beneficial at our northern latitudes. It is important to recognize that exposed mass elements are



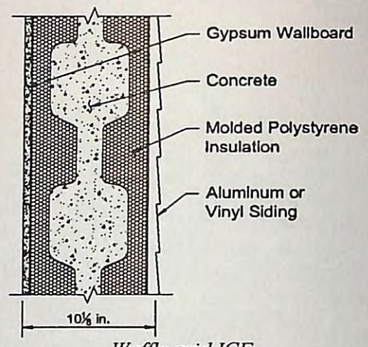
Trombe Wall with exterior insulating shutter


Gypsum Wallboard
2x4 or 2X6 Wood Framing w/ Fiberglass Insulation
Wood or Insulated Sheathing
Aluminum or Vinyl Siding
5¼ - 7¼ in.

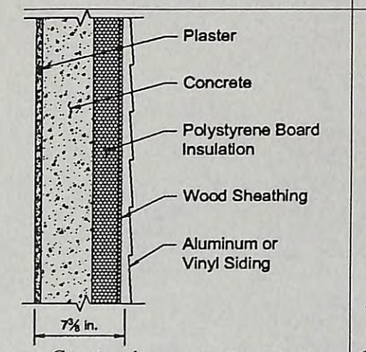
Standard wood frame wall



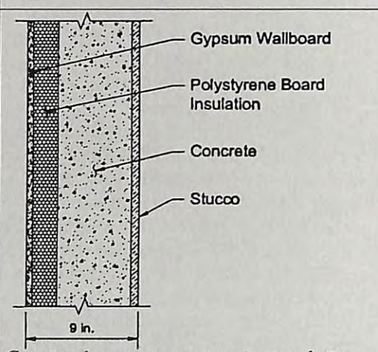
Flat panel ICF



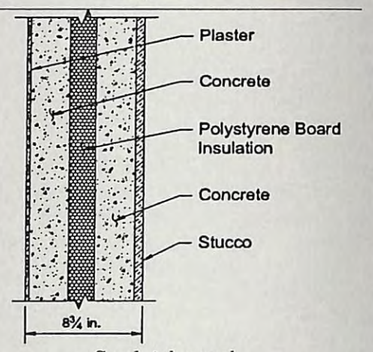
Waffle grid ICF



Cast-in-place concrete, exterior insulation



Cast-in-place concrete, interior insulation



Sandwich panel

only thermally active in their surface layer. For thermal mass to be effective, there must be some temperature fluctuations. It is the top two to four inches of a mass element that are thermally active, storing heat and releasing it on a daily basis. As the room cools down, the mass wall is warmer and radiates heat into the room.

Thicker elements have too much storage capacity for a daily thermal cycle. They are not likely to be charged but become an absorber, since a cooler surface than its surroundings keeps absorbing heat.

How much heat does concrete store?

Standard concrete can store about 47 BTU per inch thickness for each degree Farenheight rise in temperature for each square foot of area. Thus each square foot of a 3 inch thick slab that changes 10 °F in temperature will release (or absorb) about 142 BTU. By comparison, water can store about three times the amount of heat, about 426 BTU for an equivalent amount of water.

Thermal mass inside the house also helps moderate indoor temperature fluctuations.

In colder climates, high mass masonry and concrete buildings must be insulated appropriately. There is a reason why woollen sweaters and booties were created in northern climates. It was cold in those buildings, so you needed to be dressed for the occasion and season. We have forgotten that today, as we are inclined to walk around the home in bare feet and shorts year-round, regardless of the outdoor conditions.

Anyone who has visited or lived in places such as northern or central Europe will appreciate this. Those old historical buildings are extremely uncomfortable because of their large, uninsulated thermal mass.

The cement industry has made a big effort to gain a larger share of the residential construction market. Insulated concrete forming (ICF) systems are being aggressively marketed. Excessive claims are also being made that concrete homes have performance levels equivalent to R-40 walls. Unfortunately, this is not the case.

To deal with some of the performance issues

and to promote the benefits of high mass construction, the Portland Cement Association did a study. The energy consumption of a four-bedroom, 2,450-square-foot two storey single-family house was modelled. The house design was typical of current suburban construction, but assumed to be slab-on-grade. Typical residential construction materials and practices were assumed.

Calculations were done for 25 locations across the United States and Canada. The differences in annual energy consumption resulting from the use of different types of exterior walls were compared.

Eleven types of exterior wall construction were modelled. These included conventional wood frame walls and steel frame mass walls made of autoclaved aerated concrete blocks, concrete masonry block walls, insulating concrete forms, concrete sandwich panel walls with integral insulation, and cast-in-place concrete walls with exterior or interior insulation. (Table 1)

Wood frame walls were assumed to be 2x4 or 2x6 wood studs at 16-in. centres, ½-inch gypsum wallboard on the interior surface, and ½-inch OSB or plywood sheathing with aluminum or vinyl siding on the exterior surface. Cavities were assumed to be insulated with fibreglass insulation batts.

To ensure that only differences in wall construction were being compared, all other building elements and conditions were kept identical – including temperature settings, internal loads, air leakage, roofs, floors, windows, interior walls, and the type of heating, ventilation, and cooling (HVAC) systems. Since energy modelling software cannot readily model perimeter insulation, basement or slab-on-grade, perimeter or under-slab insulation was not considered. As a result, energy use was dependent solely on the properties and components of the exterior walls.

The study assumptions for insulation levels used minimum local energy code requirements. For Canadian locations, the compliance approach of the 1997 Model National Energy Code of Canada for Houses (MNECH) was used.

The properties of the exterior walls that affect the energy use of the house include the type and thickness of the insulation, thermal mass, and air infiltration. Heat loss through a frame wall is dependent on the amount of insulation. More insulation typically means less heat loss and less energy for heating and cooling.

Table 1. Mass Walls Modelled

Wall Type	Location of Thermal mass	R-value	Heat capacity *(BTU/lb°F)*
Flat panel ICF *(2 layers expanded poystyrene separated by 6 inches of concrete with plastic ties)*	isolated	21.73	18.5
Waffle Grid ICF *(9 inch thick, moulded expanded polystyrene with metal ties)*	isolated	13.3	12.8
Engineered sandwich panel *(2 layers of 3 inch concrete separated by 2 inch extruded polystyrene insulation)*	interior & exterior	11.23	18.1
Interior insulation *(6 inch concrete wall with 2 inch extruded polystyrene insulation)*	Exterior	11.23	18.0
Typical sandwich panel *(2 inch concrete on exterior, 2 inches extruded polystyrene insulation and 8 inches prestressed concrete)*	Mainly interior	11.1	29.0
Exterior insulation *(4 inch concrete, 2 inches expanded polystrene insulation)*	Interior	9.9	12.2
Concrete block wall *(8 inch thick, uninsulated cells, interior wood furring R-12 or R-19 batt insulation)*	Exterior	12.8 or 17.2	

The impact of thermal mass is poorly understood by many. Thermal mass walls can have a significant effect on the heating and cooling energy because they can store and later release heat. This tends to moderate indoor air temperatures, and can reduce energy associated with heating and cooling.

For warmer locations (less than 3,500 HDD65°F), US energy codes give credit for exterior walls with a heat capacity of greater

Some insulated concrete foam form sales people claim insulating values of R-40 or more for their products, but most products are a variation of the flat panel ICF with a total thickness of expanded polystyrene foam (EPS) of 4½", for an effective R-value of about R-21.

Quad-Lock, a Canadian ICF manufacturer has a product that can actually provide R-32 or R-40. By combining EPS panels with variable thicknesses, the higher R-Values can be achieved. The thickest panels (4¼" thick EPS on the exterior) were developed to deal with higher insulation standards that are being introduced in Europe.

Information: Quad-Lock Building Systems www.quadlock.com
tel: (604) 590-3111 Toll Free: 1-888-711-5625
Fax: (604) 590-8412

Energy Use of Single-Family Houses with Various Exterior Walls *by John Gajda for Portland Cement Association and Concrete Foundation Association*

than 6 Btu/sq.ft.-°F. They can have less insulation than frame walls because the code recognizes the benefits of thermal mass. A wood frame wall with a brick veneer does not qualify for this credit.

Mass benefits are not described in the MNECH, because Canadian climates are colder, so insulation is much more important and thermal mass does not have the same impact.

The analyses showed that energy for heating and cooling energy accounted for 17 to 65% of the total annual energy cost, depending on the location. Due to their thermal mass, houses with concrete walls had lower heating and cooling costs than houses with frame and code-matching walls, except for locations where the concrete walls were extremely underinsulated. However, annual heating and cooling costs are highly climate dependent. The impact of thermal mass is not as significant in colder climates as in the warmer south. (Table 2)

Sensitivity analyses were performed to determine the effect of building orientation and air leakage into the conditional space. The effects of orientation were found to be significant. ☼

Table 2 Heating and Cooling Cost Savings Based on the Code-Matching Wall

Location	Wood Frame	Steel Frame	Concrete Masonry units	ICF		Sandwich panel (typical)	Cast in Place	
				Flat panel	Waffle grid		Interior insulation	Exterior insulation
Halifax, NS	2%	2%	5%	6%	(-1%)	(-1%)	(-7%)	(-7%)
Quebec City, QC	1%	2%	3%	4%	(-3%)	(-5%)	(-8%)	(-9%)
Toronto, ON	1%	1%	5%	9%	3%	3%	(-2%)	(-1%)
Winnipeg, MB	1%	1%	4%	8%	2%	2%	(-3%)	(-2%)
Vancouver, BC	4%	1%	11%	19%	13%	15%	9%	9%
Albuquerque, NM	11%	5%	18%	25%	20%	23%	16%	19%
Boston, MA	4%	2%	9%	17%	11%	12%	6%	8%
Chicago, IL	1%	2%	6%	13%	7%	8%	2%	4%
Tampa, FL	27%	22%	23%	38%	35%	38%	32%	35%

Percent change in enegy consumption for space heating and cooling, based on a code matching wall. Bracketed negative numbers mean that *more* energy is needed for heating and cooling. Wall construction is described in the text. This table has been edited for brevity, but includes all Canadian locations used in the study.

Insulating Masonry Walls

As buildings age they need to be repaired. Older buildings with solid masonry exterior walls are also renovated. As well, commercial and industrial buildings, many of which were never insulated, are converted for residential use. To increase their energy efficiency and occupant comfort, thermal insulation has to be added to the solid masonry walls.

There is uncertainty and controversy within the design and construction community about the best way to insulate older solid masonry walls in a way that improves performance without affecting durability.

Adding insulation on the interior of solid masonry walls is often considered the best way to increase energy efficiency and occupant comfort. However, solid masonry walls with little or no thermal insulation are subject to a large temperature gradient. During the heating season, heat flows outward from the inside warming the masonry, thus helping to dry it. Insulating from the outside would be the best way to provide optimum performance and ensure the integrity of the masonry walls. However, that is not always a practical option, especially in the case of historic buildings where the aesthetic features of the exterior facades must be preserved, so new insulation is restricted to the interior of the building.

Adding insulation on the inside lowers the overall temperature of the masonry during the heating season and can increase the risk of condensation and frost inside the wall, as well as reducing the drying potential. When commercial or industrial buildings are converted for residential use, the new residential use may also generate higher indoor relative humidity levels and different air pressure regimes than those maintained in the past. The combination of colder temperatures, longer drying time, increased relative humidity levels and different air pressures can adversely affect the integrity and durability of the building envelope. To reduce the risks related to increasing the insulating levels, it is important to try to control the sources of exterior and interior moisture.

Work is underway to create guidelines to help builders and designers avoid problems associated with insulating solid masonry walls. Preliminary results from this work were presented at the Ninth Canadian Conference on Building Science and Technology in Vancouver.

Concerns Related to Increased Insulation

To minimize rain penetration into wall assembly. Rain penetration is a large potential source of water. The addition of insulation must be combined with a detailed inspection and repairs of the exterior face of the masonry and mortar joints in order to minimize water intrusion.

To minimize the penetration of indoor humidity into the wall assembly by water vapour diffusion. A continuous vapour barrier within the wall assembly is needed to reduce moisture movement by diffusion. The vapour drive, location and rate of condensation within a wall assembly depends on several factors, including the type of wall materials, as well as the temperature and relative humidity conditions maintained inside the building during the heating season.

To minimize the penetration of rainwater and indoor humidity into the wall assembly through air infiltration and exfiltration. The assembly must include a continuous air barrier system across its entire surface to minimize humidity transfer into the wall system due to exfiltration of indoor air.

To minimize the temperature drop within the wall assembly. A balance must be reached between the need for durability and the thermal performance of the building.

To minimize the air pressure differential across the exterior wall assembly. The air pressure difference across the building envelope is the driving force for exfiltration of warm, moist indoor air through the wall assembly. Mechanical systems should be balanced to maintain a relatively neutral air pressure across the building envelope.

Recommendations for Insulating Masonry Walls

Sprayed polyurethane foam insulation is a good insulation choice. It has excellent air tightness characteristics, provides continuity at junctions with walls, ceilings, floor and window perimeters, and can be applied over irregular surfaces. There is also good control of total thickness. The polyurethane foam acts as the main air barrier material of the wall assembly with transition membranes installed at critical locations, such as around window perimeters.

Polyurethane foam can also provide the vapour barrier, provided the foam is thick enough.

The following general recommendations are suggested when adding polyurethane foam insulation over existing solid masonry walls:

- Repair all holes in the interior surface and consolidate loose masonry to ensure a sound substrate for the application of the foam insulation.
- The air barrier and insulation (sprayed polyurethane foam) should be continuous at the floor joists, floor slabs and adjacent components, including the window interface, to ensure continuity of the air barrier and insulation system.
- Transition membranes are recommended at critical locations, such as around window perimeters.
- Indoor relative humidity levels and building pressurization should be controlled to minimize vapour pressure gradients. ☼

Insulating Solid Masonry Walls, a paper presented at the Ninth Canadian Conference on Building Science and Technology, Feb. 27-28, 2003, in Vancouver by Mario D. Goncalves

Mr. Mario D Goncalves, Eng. is a Senior Building Consultant and President of Patenaude-JBK Inc., Varennes, Quebec

Design Criteria for Moisture Control in Buildings

As the number of people diagnosed with asthma increases each year, the awareness of "sick building syndrome" also grows. Careful design and control of the interior environment becomes ever more critical. An essential component in maintaining good indoor air quality is controlling interior relative humidity.

Energy efficiency upgrades of older homes and new airtight energy-efficient construction practices have been blamed for high indoor moisture conditions at various times of the year. High indoor moisture loads can cause problems such as condensation on interior surfaces and windows, mould growth, musty odours, and the deterioration of interior furnishings. We know that fungi, mould, and dust mites flourish in damp areas and can cause health problems such as allergies and asthma.

During the winter, indoor humidity depends on a combination of sources such as people, groundwater through the foundation, and building ventilation. Indoor air quality will be jeopardized by airtight construction only if no ventilation is provided.

A lot of moisture can be produced inside a home. Moisture control in homes depends on the amount of moisture generated, the climate where the building is located, and the design and operation of the ventilation system. Water vapour is typically removed by air change – either by natural air leakage through the building envelope or by mechanical ventilation systems.

The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) recommends that indoor temperatures be maintained between 68 and 75°F (20 - 23.8°C) during winter and between 73 and 79°F during the summer. In practice, complaints occur if the temperature is not maintained at about 72°F (22°C).

When exterior building envelope elements are designed, if interior environmental loads are considered they are treated as constants. However, indoor conditions in homes are dynamic, always changing depending on occupant activities, the capacity of the structure to store moisture, and time of year.

Optimum indoor relative humidity (RH) should be maintained between 30% and 55%. Indoor humidity below 30% can cause our mucous membranes to dry reducing the body's immunity while RH above 60% for extended time periods promotes indoor microbial growth. Unlike temperature control, humidity control in homes is rarely considered other than as a by-product of mechanical cooling air, although moisture is the biggest problem.

When designing exterior building envelope elements, such as wall or roof assemblies for residential buildings, interior environmental loads are typically considered as constants, if they are considered at all. However, indoor conditions in homes are dynamic. They are always changing depending on occupant activities, the number of plants within a dwelling, and the kind of objects inside that are capable of storing moisture, and time of year. In extreme climates (like the Prairies), houses need to be humidified during the winter.

When doing a moisture analysis for building envelope design, proper choice of indoor environmental conditions is important, especially for buildings in cold climates. Standard practice when design for moisture control is considered makes use of a single point assumption for interior conditions. As a result, moisture performance modelling is not always appropriate, since moisture generation varies. Some European countries have defined Indoor Climate Classes in recognition of this variability.

The steady state calculations are done to determine the dew point. The assumption is that condensation will take place if the condensing surface falls below the dew point temperature, so the focus of design is to keep temperatures above the dew point to prevent condensation. However, many building failures, such as mould and mildew, the buckling of siding and paint failure are not necessarily related to surface condensation. Some wetting could be tolerated, depending on the materials, the temperature and the speed at which the materials are able to dry out.

The current edition of the ASHRAE Handbook of Fundamentals also points out that wetting or drying cycles can't be analyzed easily with steady state tools because these do not consider the moisture storage ability of building materials.

Moisture storage in construction materials helps stabilize the indoor humidity, so that daily or even weekly averages could be used for the purpose of building moisture analysis. The standards should require analysis using at least two or three possible ranges of interior moisture production, such as low, medium, or high.

A study of multi-family dwellings in Seattle found that, in general, measured indoor moisture levels are lower than those found in handbooks. On the other hand, measurements in some Vancouver area social housing unit systems showed winter RH in the 70% range. However, these tended to be small units with high occupancies and no ventilation systems.

Comparing measured interior moisture production rates to calculated ones may produce different solutions in moisture performance modelling analysis and different recommendations for exterior wall systems. The advanced design and modelling tools currently available can incorporate changing interior conditions, such as fluctuations in temperature and relative humidity, into the analysis of wall performance.

Some moisture sources are not related to the operation of the building. These include the construction moisture content of the building materials, groundwater through a basement floor and walls, and basement and crawlspace walls storing and moving large quantities of water vapour to the interior. Leakage of wind-driven rain and exterior water into the building envelope also adds to seasonal moisture storage effects. Most of the time each source of moisture is independent of the other, but combined together, they may account for significant amounts of water that can affect interior conditions and the building envelope performance.

Whether vapour retarders or ventilation systems are more important depends on the interior and exterior moisture conditions that the building is expected to sustain. Traditional design makes a simplified single point assumption - a single temperature and humidity condition to determine the dew point. In reality, the conditions are constantly fluctuating.

In Seattle's mixed-humid climate, exterior vapour pressure is typically greater than interior vapour pressure four to five months of the year, which limits an exterior wall's ability to dry to the outside. When drying to the exterior is limited, building enclosures either need to have the ability to safely store moisture within the wall until exterior environmental conditions allow drying to the outside, or the walls need to be designed to dry to the interior as conditions warrant. Thus, the choice of indoor boundary conditions is a critical variable in analyzing the ability of a wall to dry out. Conservative design decisions with respect to the moisture performance of exterior wall systems may lead to material choices that can ultimately be more harmful to the long-term performance of the building enclosure.

A standard moisture analysis using a single temperature and humidity conditions for Seattle showed that a vapour barrier would prevent the relatively high interior moisture loads from collecting in the exterior walls. Using these results, a designer would likely not consider any wall system that did not employ some type of robust vapour control strategy. While this result seems logical, the indoor boundary conditions did not correlate well with the relative humidity and temperature values that were measured in Seattle. Modelling results showed that walls with a polyethylene vapour barrier were not able to dry as much as the same wall with a more permeable vapour barrier, such as two coats of latex paint.

So, what should the responsible designer do?

- ☞Use measured data where possible.
- ☞Don't rule out the possible benefits of different vapour retarding strategies based solely on results from computer models using standard design conditions.
- ☞Run moisture performance models using at least two of three indoor laundry conditions. (High, medium or low moisture levels). ☼

A New Look at Residential Interior Environmental Loads by Michael Aoki-Kramer and Achilles N. Karagoizis. A paper presented at the Ninth Canadian Conference on Building Science and Technology, Feb. 27-28, 2003, Vancouver

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Canadian Energy Star Program for Windows

Natural Resources Canada has published Canadian ***Energy Star*** criteria for windows sliding glass doors.

Energy Star is a voluntary marketing program that identifies energy efficient products to consumers so they can make sound decisions when selecting high performance windows.

The Canadian criteria for Energy Star qualified windows is slightly different than for US products, although the evaluation criteria are the same. They have been primarily developed for products installed in low rise (three stories or less) residential or light commercial buildings.

Information:
www.energystar.gc.ca

Since there is a wide range of climate zones in Canada, four zones have been established in Canada, based on heating degree days.

Zone	Heating Degree Days (DD°C)	Region
A	less than 3500	West coast of BC
B	> 3500 < 5500	southern Ontario & Quebec, southern Interior BC
C	> 5500 < 8000	Prairies, northern Ontario & Quebec
D	more than 8000	Northern Canada

All windows and sliding glass doors in the US Energy Star window and door program can claim that they are Energy Star qualified in Canada using the US Northern Zone U-value of 2.00 (0.35) until March 31, 2004. After this date, they must meet the Canadian levels.

Products may be qualified using either U-value (U = 1/R) or Energy Rating (ER). Values given in the tables are for total product performance only, not centre-of-glass.

The thermal performance data must be third-party certified by organizations accredited by the Standards Council of Canada for the certification of window products (such as CSA), or approved by the US Department of Energy for the US Energy Star for Windows and Doors Program (such as the NFRC). For products certified according to NFRC standards and procedures, a manufacturer may calculate the ER using the procedures detailed in the CSA A440.2-98 Standard. Air-tightness results do not have to be third-party certified, but must be derived according to the procedures and requirements in the CSA A440.0 Standard by a laboratory accredited by SCC for air-tightness testing of fenestration products.

Canadian Energy Star Window and Sliding Glass Door Performance Levels

Zone	Maximum Air Leakage Rate ($m^3/h)/m$		MaximumU-value $W/m^2°CK$ (BTU/hr-sq.ft.°F)		Minimum ER(opening)	Minimum ER(fixed)
A	1.65	and	2.00 (0.35)	or	-16	- 6
B	1.65	and	1.80 (0.32)	or	-12	- 2
C	1.65	and	1.60 (0.28)	or	-8	+ 2
D	1.65	and	1.40 (0.25)	or	-5	+ 5

These criteria are effective April 1, 2005
An air leakage rate of 1.65 ($m^3/h)/m$ is the maximum allowable for an A2 tightness level for the CSA A440.0 Standard.

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

Energuide Ratings for Gas Fireplaces

Energuide Ratings for gas fireplaces will start to be found in manufacturers' literature over the next few months. This will help consumers make an informed decision when purchasing a gas fireplace.

The fireplace efficiency of vented gas fireplaces will be tested and verified using a recently published CSA P.4.1 "Testing Method for Measuring Annual Fireplace Efficiency" test method. Effective September 2003, all hearth product manufacturers and distributors will be required to test and certify their units.

There is no minimum energy performance standard at this time, but the fireplace efficiency numbers should encourage the use of more efficient units. It should also discourage the use of fireplaces with 60,000 BTU output in small homes!

It is not mandatory that each product be labelled. Instead, it will be a voluntary rating program, administered by HRAI, that will encourage dealers to use the well-known EnerGuide format in product literature rather than requiring a label to be affixed to each appliance.

Information: www.hrai.ca

How Effective is Cleaning a Floor?

Homeowners are offered a wide range of advice as to the type of flooring, the type of cleaning products and cleaning methods that would best reduce personal exposure to fine dust and particulate matter. This advice comes from product manufacturers and distributors (via advertising and product claims) as well as from the care-giving sector (medical doctors and public health providers).

People are correct to be concerned about fine dust in their homes. Research has shown that higher exposure to particulate matter (PM) happens indoors, especially with in-home activities such as cleaning or walking, especially on carpeted floors.

Since we spend most of our time indoors, exposure to fine indoor particles may be more important than outdoor dust. Recent research has identified a direct relationship between respirable and inhalable fine particulate matter and health. Fine particles found indoors can be dander, allergens, chemical substances, mineral particulate, viruses and bacteria.

Is it possible to clean a floor? How effective are cleaning practices?

The conventional approach to evaluating cleaning effectiveness is to put a known amount of artificial dust on the floor. The floor surface is then cleaned and the amount of remaining dust is measured. The challenge when testing is to ensure that the artificial dust mix properly represents the mix of inhalable sized particulate matter . As well, tests need to evaluate how much fine particle matter is likely to be stirred up from the floor back into the occupants' breathing zone by normal household activity. Some studies of cleaning effectiveness have measured the PM remaining on a surface after cleaning and the airborne PM during cleaning.

A recent CMHC study evaluated several cleaning methods on different surfaces with respect to their relative effect on the PM exposure of an individual living in the home. Simulated household activity was performed before cleaning. The floor was cleaned, and then the activity was repeated immediately after cleaning. Cleaning was done weekly in one room of each house by the same person using a different cleaning device each week. The carpeted floor was replaced by a smooth floor and the cleaning program was repeated.

Results showed that, during cleaning, carpeted floors have higher levels of dust re-suspension in all particle sizes than smooth floors, but the smallest particles are not stirred up as much as the larger ones.

Significant differences in performance between different cleaning devices were not noted, even though many of the devices claimed to be more effective than others. Although the ordinary house broom was found to have high dust particle re-suspension rates during use, its cleaning effectiveness was similar to other devices. Dry or wet pad sweeping devices for smooth floors were no better than a conventional dust mop.

A carpeted floor has a greater tendency to accumulate fine (PM10 and PM5) particles over time than a smooth floor, but this varies greatly from house to house and from room to room.

Based on the limited data in the study, it appears that new carpet does not stir up as many particles as old carpet but slightly higher levels than a smooth floor. Since it is impossible to completely clean the carpets, and since they attract the small particles over time, there is a larger reservoir of particulate matter that can be re-suspended as the carpet ages.

High-cost vacuum cleaners with special filters and other add-on features generally do not work better than other cleaning devices. When cleaning effectiveness on smooth floors after one week's elapsed time was evaluated, it was found that the ordinary upright cleaner was better than all of the other cleaning devices.

Overall, there was no apparent difference between the performance of vacuum cleaners and sweeping devices on smooth floors.

Floors did not become cleaner with time. Weekly vacuuming the way it is normally done is not enough to produce a meaningful reduction in particle re-suspension rates. In order to produce a meaningful reduction in particle re-suspension, it appears that cleaning has to be more frequent and vigorous than the weekly cleaning done in this study or that is likely to be done by most homeowners.

There are clear differences between smooth and carpeted floors with respect to the fine particles that are re-suspended by cleaning and normal household activity. ☼

Indoor Particulate and Floor Cleaning
Bowser Technical Inc. for CMHC Research Division

Technical Research Committee News

Canadian Home Builders' Association

The Electrical Code

The Canadian Electrical Code is revised every four years. It is a model code that is adopted by provincial authorities. Just as the changes in the last edition are being felt on the job site, a new cycle is starting. New requirements being considered include the expanded use of both arc fault and ground fault circuit interrupters. CHBA has asked for solid cost/benefit analysis to be the basis for any future decisions.

Health in Housing - Mould

The Institute for Research in Construction at NRC announced it's intention to work with the Healthy Indoors Partnership to develop a national research agenda and to bring forward balanced and validated information to help deal with the many issues associated with the indoor environment. A workshop is planned for the fall.

In response to a call from the TRC for practical information on how to deal with mould, CMHC has agreed to prepare an inventory of the best sources of information on mould and what to do when it is present.

Moisture in Exterior Wall Systems

Extensive research by an IRC-led consortium on the performance of external wall assemblies is now complete and will be the subject of the next round of Building Science Insight Seminars to be delivered by the IRC across the country in the Fall of 2003. The TRC remains concerned about the need to format this new information in a way that it reaches the job site.

Incompatible Building Materials

Over the past year, CHBA members have provided examples of problems between building materials on the job site. This information has been used by CMHC to produce a new database which will soon be accessible on-line.

Radiant Heating Standard

The Canadian Codes Centre has proposed that the new CSA standard for radiant heating systems be referenced in the 2005 Building Code. CHBA will review this new standard and work with the Canadian Institute for Plumbing and Heating to resolve any issues found.

Insurance

The CHBA has taken a number of steps in response to a growing crisis sparked by dramatically rising insurance rates and shrinking coverages, including:

- meetings with the Insurance Bureau of Canada to develop reasonable 'warranties and conditions'
- working with CMHC on a study of the situation and its impact.
- informing MPs of the problem.
- the CHBA prepared a new publication entitled ***How to Manage Risk*** which has been mailed to all CHBA Builder members.

Stopping Bad Things from Happening

When good things happen, they are easy to appreciate. CHBA has helped to make a lot of good things happen over the years. CMHC's low down-payment plan and the GST rebate for the purchase of new housing are just two of many examples where the association's efforts have helped to produce tangible benefits for members. CHBA has also lobbied on many issues which have stopped bad things from happening. The association has put together a list of cases where it was successful and members benefited because nothing (bad) happened.

2005 Building, Plumbing and Fire Codes

The recently completed public consultation focussed on 1,300 proposed changes to the Codes. In its submission, CHBA identified 16 proposed requirements that should be modified or dropped. The outcome will not be known until early 2004. However, the CHBA has already stopped a number of new requirements from making it into the proposed set of changes by working effectively with the provincial HBAs. This included new stair requirements and a second exit from the basements of all new houses.

The Scope of the National Building Code

Since 1995, the National Building Code has been under review to determine the underlying objectives for every requirement. The Objective-based Code Process effort is intended to make it easier to use innovative solutions. At one point 16 'root' objectives had been identified. CHBA argued for a much tighter framework of 'root' objectives. The result is a framework with only four 'root' objectives; namely: Health, Safety, Accessibility and Fire and Structural Protection of Buildings. By defining these objectives as narrowly as possible, the room for new requirements is reduced. Also, some existing requirements in the Code no longer fit under any of the four objectives and have been identified for elimination.

In future, any new requirement will have to be linked directly to one of the four 'root' objectives to be considered for inclusion in the Code. CHBA has also pressed for consideration of cost information before a change is considered. This will make it much less likely that costly new requirements will find their way into the Code in future.

Health and Housing

There has been much discussion about indoor air quality in recent years. CHBA's Report on Health and Housing concluded that research on this subject is very preliminary and that there are more questions than answers. CHBA is concerned that flawed studies could cause problems not only for manufacturers and suppliers, but also for builders having to deal with the erroneous concerns of their customers. CHBA will continue to demand better accountability by government on this sensitive issue.

The Kyoto Protocol

During the recent public consultations on how to reduce green house gas emissions, there were strong advocates for dramatically increasing energy efficiency requirements for new housing. CHBA argued for voluntary, market-driven initiatives and was successful in shaping the recommendations from the committee dealing with buildings to reflect this position. More recently, proposals for new regulations have re-emerged as a real threat to the cost of new construction. The CHBA will continue to point to the success of the housing industry in outperforming all other sectors of the economy based on a voluntary, market-driven approach as governments continue to consider their options.

The Fire Resistance of Floors and Walls in Houses

The National Building Code does not require the structure of houses to be fire resistant. With new materials coming onto the market that might not provide the same level of fire safety as traditional construction, the Institute for Research in Construction initiated a testing program to measure the performance of various assemblies. CHBA was concerned that this could lead to confusion unless a thorough analysis of the problem was done before the testing started. CHBA presented its case to the commission responsible for the National Building Code and, as a result, the testing program was halted pending a proper study of the time required to evacuate houses and other factors affecting risk.

The Use of Furnaces for Heating during Construction

Over the last two years, CHBA has worked against a move to prohibit the use of furnaces for temporary heat during construction. With a lack of clarity in the regulations, furnaces have long been used for this purpose in many areas of the country. However, in 2000 Ontario indicated that it intended to enforce a long-ignored regulation prohibiting their use. Other jurisdictions across the country may then have followed suit. CHBA became involved in the CSA process to ensure their support for using furnaces for temporary heat. While not yet completely resolved, there is reason for optimism that an acceptable solution will be found and builders will be able to continue with this practice.

Stairs and Handrails

The Standing Committee on Houses was asked to consider a number of changes to the requirements contained in the National Building Code for stairs in houses. Among the proposed changes were new requirements that would add to the minimum length of a run of stairs and to the headroom above them. CHBA, together with the Canadian Manufactured Housing Institute, assembled a brief that demonstrated the cost impact of these changes on standard starter homes. It presented its case to the Standing Committee and was successful in heading off the inclusion of these and other costly changes to stairs and handrails in the next edition of the Code.

Roof Truss Design

Many structural requirements in Part 9 of the National Building Code are derived from experience rather than through systematically applied engineering principles. Over the past decade, these requirements have been revisited to ensure they are consistent with an international convention based on 'limit state design.' When these principles were applied to requirements for roof-truss design, the result was an increase in the size of lower chord members that would have added approximately $200 to the cost of a typical roof. CHBA recommended a change in loading requirements. The effect is no increase being required in the size of truss members. ☼

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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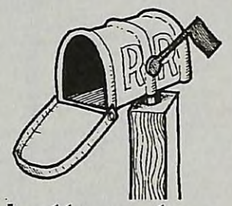


Letters to the Editor

Re: Vapour Diffusion Ports: Do They Help Walls Dry Out? (Solplan Review No. 110, May 2003)

There seems to be some controversy about this practice of perforating the air barrier. In some cases I think the ventilation of closed-off areas of a wall can be of some benefit, depending upon the type of cladding and exposure, but have you considered the phenomenon of reverse vapour drive? Having holes in the air-barrier when conditions cause reverse vapour drive compound the problem and add to a repetitive cycle of wet/dry conditions resulting in decay. However if the air barrier is intact there can be no airflow and therefore no moisture and consequent condensation.

James Jackson
Abbotsford, BC

I agree with you that if the OSB or plywood sheathing were intended to be the air barrier there could be a problem. As you point out, the air barrier must be continuous. However, the sheathing is seldom intended to be the air barrier. As an air barrier it would have to be completely air tight, and all joints sealed. In practice, the sheathing never is. Gaps are deliberately left between panels to allow for wood shrinkage. As you point out, if airflow across the building envelope is stopped, there will be no moisture movement other than the small amount that could be moved by vapour pressure.

You are right to raise a concern about reverse vapour drive. This can take place any time after a storm, when the sun comes out and quickly warms the surface of the wall. At that point the warm surface has a higher vapour pressure than the cooler interior face of the wall, so the vapour drive will be inward. In this way moisture can be moved into the wall. Depending on the time of day, this only occurs on east to west faces of the building, with perhaps the strongest vapour drive being on the southwest to west faces. However, in practical terms this is a short-term phenomenon; for as soon as the sun sets or more clouds roll in, the exterior will cool, thus restoring the outward moisture drive.

A more important consideration is the vapour permeance of the sheathing material itself. Plywood has some permeability, especially at higher moisture content, but OSB does not.

It is also important to note that the wall systems tested were all built with rain screen cavities. Thus, even if there were to be a reverse vapour drive, the moisture would not penetrate into the wall assembly itself, but encounter the rain screen cavity first. The rain screen cavity is vented, so although the humidity may rise under reverse vapour pressure drive conditions, there should not be any direct moisture contact with the sheathing. All evidence shows that vented rain screen cavities enhance the drying ability of wall systems and reduce the likelihood of moisture problems.

The issue you are raising is the importance of considering the entire wall system. To provide the appropriate water, air and vapour resistance, we need to consider how all the wall materials are assembled. Ed.

HELP WANTED

Passionate people only need apply.

Mattamy Homes, headquartered in Oakville Ontario, is Canada's largest residential homebuilder, distinguishing itself on quality of product, innovation in design, and building not only "homes", but also whole communities. In 2002, Mattamy Homes closed over 3,100 homes and was honoured as Homebuilder of the Year by the Greater Toronto Homebuilders' Association.

Mattamy Homes is looking for a highly motivated and qualified candidate to champion environmentally responsible building design and energy efficiency as head of our new Building Science Department. The ideal candidate will have a broad range of experiences in residential home construction employing green building techniques.

The work will cover the full range of business, technical and human aspects of green building. Responsibilities will include identifying opportunities to 'green traditional building methods'; to ensure Mattamy has a prominent presence in the development of residential construction projects in the GTA and beyond; to influence and or modify company policy, and building design and techniques towards green practices. We require an individual who will understand 1) construction performance standards and materials as well as 2) processes that strive to green building excellence that are appealing to homebuyers while keeping in mind affordability and sustainability. The candidate will also be responsible for managing cooperative education programs as Mattamy's liaison with area Boards of Education that sponsor such programs.

The candidate should possess knowledge and or experience in sustainable building design, green building techniques, HVAC systems and energy-efficiency. The candidate must have well developed communication skills and ability to work with people inside the company as well as outside including government officials. A University education is required. Computer proficiency, (computer modeling), and knowledge of architectural design are essential.

Please forward resume and covering letter by August 20, 2003 to:

Angela Lin, Administrative Assistant
2360 Bristol Circle, Oakville, Ont. L6H 6M5
Angela.Lin@mattamycorp.com

Re: Life Cycle Environmental Impact (Solplan Review No. 110, May 2003)

I enjoyed your May issue, keep up the good work.

The article by Jamie Meil on the life-cycle environmental impact of housing got me thinking about the significance of occupant load. Having a big family has given me first-hand experience with economies-of-scale. The per-capita energy use by my family is a fraction of the previous occupants' of this house because the whole home is heated regardless of the number of people living here. When my whole family is in the living room (where the thermostat is located) body heat alone may be enough to warm us at times.

Of course it is unrealistic to expect people to crowd together voluntarily just to lessen the impact on the environment, but what about a compromise? Can we North Americans learn from the Asians, Europeans and Africans and design housing that encourages use by extended families? It seems every new North American home is designed as though no one ever gets old or mobility-challenged. I believe that increasing the number of barrier-free houses will result in increased average occupant loads. This will reduce the environmental impact of the average North American house, and every little bit helps.

Andrew Barker,
Barker Building & Consulting Ltd.
Nanaimo BC

You are correct to raise the issue of per-capita resource consumption in our homes today.

The average per-capita square footage of North American housing in the late1940s was about 400 square feet. Today the average is about 800 square feet. Yet I am seeing many houses under construction in the Vancouver area with floor areas of more than 6,000 square feet – and many of these will be occupied by a household of two or maybe three people. Ed.

Owens Corning Insulation Products Awarded Greenguard™ Certification

Owens Corning has been awarded ***Greenguard Certification***™ for Owens Corning insulating products including: PINK® fibre glass batts, all blowing wools, extruded foam, QuietZone® batts and acoustic floor mat, SelectSound® black acoustic blanket and FoamSealRÔ ridged sill gasket. The certification demonstrates that these products contribute minimal emissions to indoor environments.

Owens Corning is the first manufacturer to receive Greenguard Certification for its extruded foam board products.

The Greenguard Certification and labelling program subjects interior products and building materials to rigorous emission tests. Only low-emitting products that do not compromise the air quality of indoor environments are awarded Greenguard Certification and labelling.

The certification process involves the testing of products in dynamic environmental chambers for emissions of formaldehyde, volatile organic compounds (VOCs), respirable particles and other pollutants. The Greenguard certification for indoor air quality complies with the criteria set forth by the US Environmental Protection Agency (EPA), the US Green Building Council's LEED Program, and other organizations.

The Greenguard Environmental Institute is a global, Washington, D.C-based, non-profit organization with a scientific, third-party board to establish indoor air quality standards for interior products and building materials. It was founded in 2001 as an independent organization, and is not affiliated with or sponsored by manufacturers or industry. The Institute's goal is to improve public health and quality of life by encouraging and helping manufacturers to build better, safer products and uphold environmental practices in product development, manufacturing and distribution. ☼

Information:
www.greenguard.org

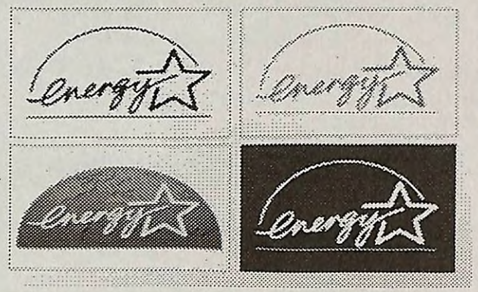
Energy Answers

Rob Dumont

What is the Energy Star Program for Appliances? I see a number of appliances in the stores with that designation.

Energy Star is an international symbol for energy efficiency that allows you to quickly identify manufactured products that are the most energy efficient in their class.

The symbol can appear in several different forms as shown in the figure. The US pioneered the marketing program, but it has now spread to Canada and several other countries.



I think that the program is a great idea, helping consumers to quickly identify the more energy efficient products.

On the large appliance side in Canada, the following household appliances have Energy Star ratings: refrigerators, freezers, clothes washers and dishwashers.

Table 1 lists the Energuide ratings for the most energy efficient Energy Star-rated appliances as of 2003 for Canada (the ratings are also available on the web at *http://energystar.gc.ca*):

As can be seen, no one manufacturer has the top performer in all four of these appliance categories.

There are as yet no Energy Star rated clothes dryers, electric ranges, or gas ranges. In fact, Canada has yet to put energy consumption labels on any gas appliances.

The improvements in energy efficiency of major electric appliances have been a real success story.

For instance, the following table shows how the annual average energy consumption values for dishwashers have declined over the last 19 years.

Table 1

Appliance	Manufacturer	Annual Electricity Consumption *(kWh/yr)*
Refrigerator with top freezer (14.5 to 16.5 cubic feet with auto defrost)	Whirlpool ET5WSEXK*0*	372
Freezers (chest type 13.5 to 15.4 cubic feet) Manual Defrost	Woods V15NAE**	409
Dishwashers (Built-in, Standard size)	Asko D1976	312
Clothes Washers (2.1 cubic foot capacity [75 litre])	Kenmore C42**	196

Table 2

Year	Average annual energy consumption of dishwashers available in Canada *(kWh/yr)*
1984	1213
1990	1026
1997	650
1999	641
2002	623

Table 3

Appliance	2001 Annual Consumption of Most Energy Efficient Model *(kWh/yr)*	2003 Annual Consumption of Most Energy Efficient Model *(kWh/yr)*	Ratio of 2003 to 2001 annual consumption
Refrigerator with top freezer (14.5 to 16.5 cubic feet with auto defrost)	437	372	0.85
Freezers Manual Defrost (chest type 13.5 to 15.4 cubic feet)	437	409	0.94
Dishwashers (Built-in, Standard size)	381	312	0.82
Clothes Washers (2.1 cubic foot capacity [75 litre])	259	196	0.76

It is impressive to see what informed government legislation has achieved in this area.

Back in 2001 I did a column on the energy consumption of appliances. For comparison, Table 3 lists the 2001 energy consumption numbers compared with the 2003 numbers.

As can be seen from the numbers, the energy efficiency of the best appliances has improved substantially since 2001, with efficiency gains in the range of 6% to 24% for those four appliances.

As I said in my 2001 column, however, much remains to be done. The US company Sunfrost produces a 16 cubic foot superinsulated refrigerator-freezer for photovoltaic applications that uses only 233 kWh per year, or 37% less energy than the best Energy Star refrigerator on the market in Canada. ☼

Pressure Washers: Is There Trouble Ahead?

Pressure washers have become popular gadgets in many workshops. They do a useful job for many applications. However, pressure washers can affect the durability of the home when used inappropriately.

Washing the siding of a house may seem harmless. In the past, if one was going to wash the house, it was probably done by hand with a hose and a broom. The water pressures were modest, and the water was clean domestic water. The moisture load on the face of the building may have been no worse than that of a bad rainstorm.

Today, washing with a pressure washer means water is introduced at higher pressures, and chances are that cleaning materials are added to the water. This changes the dynamics that could lead to unforeseen problems, as the high pressure can drive moisture into the wall assembly in several ways:

- by the sheer pressure of water driven by the force of the compressor
- through reverse vapour drive. As the washing is likely done on a warm sunny day, the surface is warmer than the interior or back of the wall, so the moisture introduced on the surface will be subject to vapour pressure differences between the interior and exterior. The warm surface has higher vapour pressure potential than the cooler interior.
- through capillary drive. Capillary forces are strong, and hold moisture in tight spaces, so washing the wall adds moisture that can be sucked in.

Although one could assume that the washing would expose a wall to no more moisture than would occur during a bad storm, any cleaning agent that might be added to the water or any oils or impurities on the building surface could dissolve in the water and act as surfactants, not unlike soap. If there are impurities in the water drops, the drops lose their surface tension and are better able to penetrate low permeance materials. This has been noted to be the case with housewraps, which are especially vulnerable to impurities in water. Once the impure water touches the materials, they loose their water resistance.

The significance of this issue is that the sheathing membranes are a key to water management in buildings. Contamination of the sheathing membrane or housewrap becomes permanent, i.e., the water resistance is permanently diminished, and homeowners will not be aware of it.

The connection between pressure washing a wall and a degraded envelope may not be made since the consequences may not be evident until much later in the year when the wet season starts.

The issue of pressure washing and building envelope performance has not been studied, but it is a potential problem that should be considered.

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IRC Preparing Building Science Insight 2003 Seminar Series

Effective Moisture Control for Light-Frame Walls of Low-Rise Buildings

NRC's Institute for Research in Construction is preparing for its 2003 cross-Canada seminar series, Building Science Insight, scheduled to launch in October. This year's subject – moisture control – is expected to attract wide interest.

As evidenced by some dramatic building envelope failures in the past decade or so, moisture is a primary agent of premature deterioration of building materials. Damage induced by uncontrolled moisture includes rotting of wood-based materials, efflorescence and spalling of masonry systems and rusting of metal studs and fasteners. Excessive moisture in the envelope may promote the growth of moulds and hence, may affect the health of occupants. The upcoming one-day IRC seminar will provide insight into the factors that contribute to effective management of moisture in light-frame walls of low-rise buildings from the point of view of building science principles as well as their application in practice. Results and new design tools derived from IRC's most recent research on moisture management in exterior walls will be highlighted. In each region, an industry expert will join the four IRC speakers.

The Program

Design principles for performance and durability. Performance requirements for wall assemblies include provisions for structural strength and rigidity, fire control, as well as control of noise, rain penetration, heat, air and water vapour flow. Additionally the wall must be durable. Means of assessment of wall performance and their relevance to design, performance testing and modelling, as these relate to moisture control, will be presented. An understanding of the relation between environmental effects and deterioration mechanisms, and the response of assemblies to these effects will provide a useful backdrop for relating climatic loads to the long-term performance of walls.

Assessing climate loads. Climatic phenomena can affect the long-term performance and durability of exterior walls. Exterior walls respond differently to different climate exposures. Understanding the nature of climatic loads and estimating their magnitude are important steps for selecting moisture management strategies for assemblies subjected to different climates. Indicators of climate severity relating to the control of rain penetration, condensation and to the potential drying of the assemblies will be explained. The Moisture Index, a new indicator developed at IRC that merges the wetting and drying potentials inherent in climates, will be described.

Rain penetration control strategies. Wall assemblies are not inherently deficiency free. Hence, water entry through openings in the cladding can occur during rainfall. Key wall design strategies that mitigate the effects of water entry will be presented. Results of IRC's latest research on water entry into large-scale wall specimens incorporating windows and other components that penetrate the wall assembly will be discussed.

Control of heat, air and moisture flow. Effective control of condensation in exterior walls depends on the application of strategies to minimize air movement and vapour diffusion into the assembly, as well as maintain critical elements above the dew point temperature. Requirements for air barrier systems and vapour barrier materials and how these affect the design of other wall elements will be examined.

Putting principles into practice. To help manage moisture in buildings, practitioners must integrate applicable theory with appropriate practice. Case studies of field problems related to rain penetration and condensation in buildings particular to regional practice will be analysed. Lessons learned will be emphasized and their implementation to improved practices discussed. In each region, a building envelope specialist from industry will contribute his field experience in the design, repair and rehabilitation of buildings and highlight recent approaches to tackling problems and generating solutions.

Applications of hygrothermal computer modelling. In most Canadian locations, one certainty about weather is that it changes constantly. Moisture flow rates, directions, dew points, wetting, accumulation and drying within the wall system are all continually changing as a result. Detailed computer simulation is a useful tool to assess the cumulative effects of all of these flows and balances over time, for many wall systems and climates in a comparative fashion. The method IRC developed to analyze situations of interest will be discussed, as well as results derived from the latest IRC studies on wetting and drying of several wall systems.

Demonstration of IRC's hygIRC hygrothermal computer model. To give participants some insights into what is involved in implementing hygrothermal models, applications of IRC's hygrothermal model to wall assemblies typical of low-rise construction will be demonstrated for different environmental loadings. ☼

Seminar Locations and Dates

Ottawa	7 October 2003	Crown Plaza Hotel
Toronto (West)	9 October 2003	Holiday Inn Select - Toronto Airport
St. John's	24 October 2003	The Fairmount Newfoundland
Halifax	27 October 2003	Holiday Inn Select, Halifax-Centre
Charlottetown	29 October 2003	Delta Prince Edward
Fredericton	31 October 2003	Sheraton Fredericton Hotel
Toronto (East)	6 November 2003	Holiday Inn Toronto - Don Valley
Whitehorse	14 November 2003	Westmark Hotel
Vancouver	17 November 2003	The Coast Plaza Suite Hotel, Stanley Park
Calgary	19 November 2003	Sheraton Cavalier Hotel
Winnipeg	21 November 2003	Winnipeg Convention Centre
Yellowknife	28 November 2003	The Regency Explorer Hotel
Edmonton	1 December 2003	The Coast Terrace Inn
Saskatoon	3 December 2003	Sheraton Cavalier Hotel
Sainte-Foy (French)	13 January 2004	Hôtel Gouverneur Sainte-Foy
Montreal (French)	15 January 2004	Holiday Inn Montréal-Midtown

For information and registration details, visit the IRC web site at:
http://irc.nrc-cnrc.gc.ca/bsi/2003/index.html
Or call Monique Myre at (613) 993-0435.

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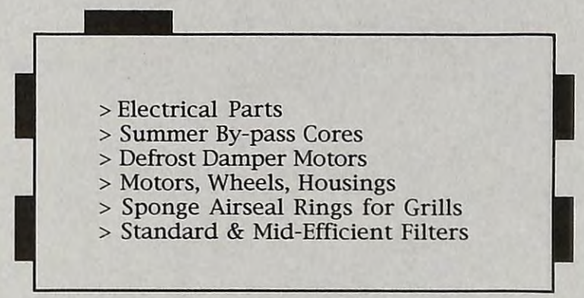

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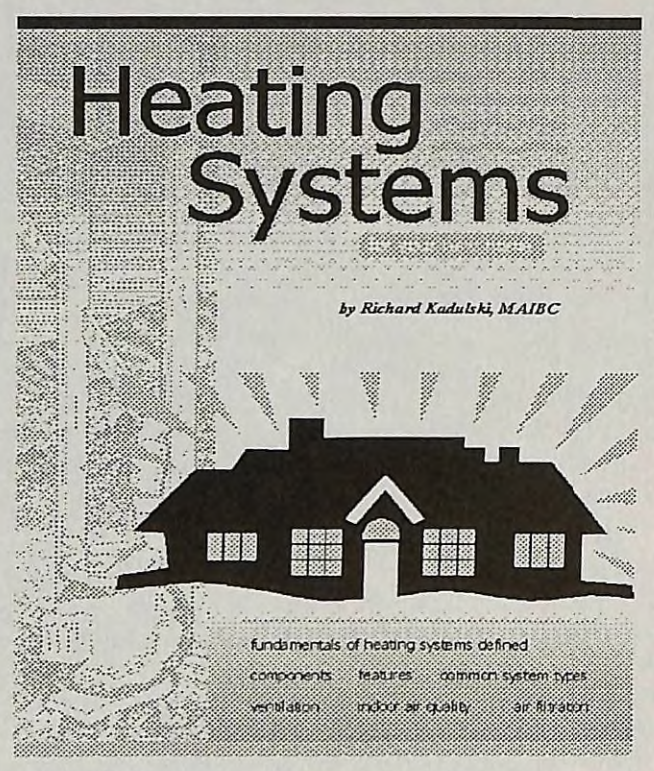

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